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CONTENTS

GRADUATION OF PRECISION CIRCLES

During the past several months the bureau has been actively engaged on the problem of graduating precision circles for geodetic instruments using the high precision circular dividing engine recently purchased and installed in the constant temperature room (see Technical News Bulletin No. 128, p. 3, December, 1927). It has been necessary, however, to design and construct considerable auxiliary equipment to use with the engine, to make certain changes in the engine itself in order to ensure satisfactory operation for the work which the bureau is required to do, and also to develop proficiency in circle graduation. The graduating of a circle for a geodetic theodolite, in which the readings are made by estimation to tenths of a second by the use of micrometer microscopes, is a very different task from graduating a circle for a surveyor's transit, and the bureau has had many difficulties to overcome.

During the past month two circles were graduated and submitted to the Coast and Geodetic Survey for tests when mounted in the theodolites for which they were made. These tests are not completed, but it is understood that the preliminary results on one circle show it to be satisfactory for theodolite use.

A further improvement of the dividing mechanism is now being carried out which it is believed will consderably increase the accuracy of graduation. This dividing engine is to be used for graduating precision circles for the Bureau of Standards and the Coast and Geodetic Survey; other high precision and special circle graduating will be undertaken, provided commercial firms can not undertake the work.

INTERNATIONAL TECHNICAL CONSULTING COMMITTEE ON RADIO COMMUNICATION

In the International Radiotelegraph Convention, adopted at the international conference held in Washington in 1927, provision was made for an International Technical Consulting Committee on Radio Communication. The general regulations adopted at the same time specified that this advisory committee should be formed, for each meeting, of experts representing either Governments or private radio-operating companies. Meetings were to be held normally at 2-year intervals, and the first one was to be convened by the Government of the Netherlands.

In accordance with these agreements a meeting has been arranged to take place at the Hague in September, 1929. American proposals for consideration at this meeting have been prepared with great care by a joint committee of Government and commercial radio engineers, acting under the auspices of the Interdepartment Radio Advisory Committee. Subcommittees were organized to deal, respectively, with (1) frequency maintenance, (2) systematization of frequency allocation, (3) transmitter interference, (4) research organization, (5) definitions

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and ratings, and (6) amateur licensing. Members of the bureau's staff have served as chairmen of three of these subcommittees.

Commercial companies in this country are sending about 10 representatives to the meeting, and the United States Government will have three official representatives supported by four technical advisers. The three delegates are Maj. Gen. C. McK. Saltzman, member of the Federal Radio Commission; Maj. Gen. George S. Gibbs, Chief Signal Officer of the Army; and Capt. S. C. Hooper, head of the communication division of the Navy. The technical advisers include Dr. J. H. Dellinger and Dr. C. B. Jolliffe, of the Bureau of Standards.

The first essential for proper allocation and effective use of the radio-frequency bands available for communication is uniform and accurate measurement of the frequencies. The best method for comparing frequency measurements of various laboratories is the exchange of quartz piezo-oscillators. Consequently, in connection with this international meeting the bureau is sending abroad a portable oscillator with thermostatic temperature control, on which measurements will be made at the national laboratories in France, Germany, Great Britain, and Italy. Comparisons have already been made with the Bell Telephone Laboratories and the Naval Research Laboratory, so that the series of measurements abroad will serve to give a direct comparison between nearly all the laboratories in the world which are doing fundamental work on frequency measurements.

CELLULOSE FROM SUGAR CANE

At the request of the manufacturer a sample of alpha-cellulose made from sugar cane was tested for its suitability for use in the rayon industry. Alpha, beta, and gamma cellulose, copper number, KOH solubility, ash, and iron determinations were made. From the results of these tests the pulp appears to be quite satisfactory for rayon use, as far as the properties tested are concerned. The alpha-cellulose content was high and the copper number quite low, indicating a high degree of purification. The beta-cellulose content and the portion soluble in caustic potash further bear this out. The beta cellulose made up the difference between the alpha-cellulose content and the total fiber, and the portion soluble in KOH was less than 3 per cent. The ash content was very low. Some iron was present, but it was a very slight trace.

DETERIORATION OF PAPER TOWELS

Three samples of paper towels were submitted to the bureau by the Panama Canal for test to determine their quality by comparison with a towel that was considered satisfactory. A sample of towel was also returned, the absorbency of which was found to be unsatisfactory. The unsatisfactory sample had been tested some time previous and found satisfactory. After shipment to the Panama Canal Zone and storage for a short time, this towel was found unsatisfactory owing to some form of deterioration by which the rate of absorbency was greatly decreased.

The cause for this change in absorbency could not be readily determined, so a number of towels that had been stored in the files of the paper section were retested for absorbency to determine if any relation existed between the length and character of storage and the various fibers used in making the towels. To accentuate extremely unfavorable conditions of storage, three towels were given a heat treatment for 72 hours at 100° C.

General conclusions made from the retest of towels stored under normal conditions for a period of 300 days, as well as the samples that were given an accelerated aging test, indicate that those samples containing an appreciable amount of ground-wood fibers are extremely susceptible to loss of absorbency during storage. All towels tested showed that storage conditions will change the rate of absorbency of paper towels, but the greater rate of change was noted in towels having ground-wood fiber.

PREVENTING MOLD GROWTHS ON LEATHER

Frequent requests have been received from shoe manufacturers for information on means for preventing mold growths on leather. These growths occur on sole leather which has been soaked first in water and then placed in mulling cabinets to temper. The time of mulling is often indefinite and the relative humidity in the cabinet is generally as high as 95 per cent. These conditions logically allow mold growths to start after three to five days in the case of vegetable-tanned sole leathers.

Experiments were conducted to determine whether very weak phenol solutions would have sufficient antiseptic properties to prevent mold growths over a reasonable period of time under high relative humidity conditions. It was found that vegetable-tanned sole leather soaked in a 0.2 per cent phenol solution

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and stored under relative humidity conditions of 100 per cent showed no mold growths after 200 days.

One shoe manufacturer has reported that he has followed this recommendation with satisfactory results. This simple expedient suggests that phenol or some phenol salt might be used to advantage in dressings for use on leather which is apt to mold in storage or use because of high humidity due to climatic or service conditions.

ACCELERATED TEST FOR PAINT ON WOOD PANELS

The bureau has completed some preliminary work in the development of a method for telling when a paint coating on wood panels has failed. This is essentially the method in use at the Forest Products Laboratory. Wood panels (birch plywood) with all sharp edges and corners rounded off are coated on all surfaces except the face with four coats of aluminum-spar varnish paint. The test paint (at least two coats) is put on the face. The panels are then exposed for 18 hours to the carbon-arc light and weighed. This is followed by exposure to the usual cycle. At intervals of one week they are given 18 hours light, followed by 2 hours of water spray (90° F.), the panels being weighed after each exposure. The gain in weight of the panels after the water spray is the amount of moisture absorbed through the coating. The point to be observed is the period when a large change in the gain in weight takes place. An unpainted specimen gains about 10 to 14 g. in weight when subjected to 18 hours of light followed by 3 hours of water spray. A specimen coated on all surfaces except the face with aluminum paint gains about 5 g. A specimen coated on all surfaces with 4 coats of aluminum paint gains 0.1 g. in weight. This offers a starting point and in a similar manner various paint coatings will be exposed.

PAINT FOR STREET DESIGNATION SIGNS

The District of Columbia has for some time made a study of standard cast-iron street-designation signs. This involved the material, color combinations, elevation, and direction of signs. As a result of visibility tests at night, the use of gold embossed characters on a black field was decided the best. In order to determine the most durable finish for these signs, the bureau was requested to make accelerated exposure tests of panels coated with various finishes. The system now in use consists of gold leaf characters on a black enamel background. Thus far the accelerated test has shown that substituting "gold" bronze paint for the gold leaf results in marked discoloration of the "gold" bronze.

HOT AQUEOUS SOLUTIONS AS COOLING MEDIA

Present-day practice in hardening metals is based largely upon the use of oils, water, and the aqueous solutions producing the more rapid cooling, such as sodium-chloride brines, sodium-hydroxide solutions, and water sprays at ordinary temperatures. There is a large gap between the cooling rates obtained in the customary quenching oils and in water, and this is now usually taken care of by tempering subsequent to hardening or by interrupted quenching. Such procedure is entirely satisfactory for many practical purposes, but simplification and economy, and possibly also technical advantages, would result if coolants were available to provide a more closely graded set of cooling characteristics. For this reason the bureau has investigated cooling media for quenching steels, and will publish its findings in the September number of the Bureau of Standards Journal of Research.

The practical solution of this problem is not solely one of obtaining certain prescribed cooling rates, but this is one of the important requirements. Study of the surface and center cooling curves, hardnesses, and structure of small high-carbon steel cylinders quenched in water, sodium hydroxide, sodium chloride solutions, and oils at different temperatures suggested the possibility of using some of the hot aqueous solutions to bridge the gap between the cooling rates obtained with water and oils at atmospheric temperatures.

Experiments with carbon and alloy steel tensile test specimens and gages appear to justify the view that hot aqueous solutions can provide a useful group of coolants with graded cooling characteristics for the hardening of small steel pieces. Final selection must depend upon additional experimental work, but the most promising of the group already studied are given below in order of decrease in the speeds, or increase in the times, of cooling: 5 per cent caustic soda at 20° C., 5 per cent salt at 20° C., water at 20° C., 5 per cent caustic soda at 60° C., 5 per cent salt at 60° C., water at 60° C., 5 per cent caustic soda at 80° C., 5 per cent caustic soda at 85 or 90° C.

The difficulty of reproducing results in quenching will probably increase as the temperature of the aqueous solution

approaches the boiling point of water for reasons discussed in the report, but under suitably controlled conditions it should be practicable to make use of these solutions in practical heat treatment. Likewise, there is a possibility of gaining advantages by decreasing the temperature and changing the concentration and rate of circulation of the liquid in individual cases. In any case, evidence has been given of useful properties in a group of liquids which are inexpensive and generally available for the heat treatment of steels.

MEANS FOR INCREASING RELIABILITY OF FUSIBLE TIN BOILER PLUGS

Fusible boiler plugs for safeguarding steam boilers against the dangers of low water have been in use for many years, and since 1852 they have been required in all steam vessels of the American merchant marine, except those equipped with pipe, flash, or coil boilers. They are also used in many factory and locomotive boilers.

In its usual form the fusible plug consists of an externally threaded bronze casing filled from end to end with pure tin, which has a melting point of about 231° C. The plug is screwed into the boiler in such a position that it is about 1 inch or more above the dangerous low-water level, one end of the plug being on the water and the other on the fire side. If the water in the boiler falls below the level of the plug the tin melts and is blown out, thus releasing the steam pressure and serving to prevent burning and possible explosion of the boiler.

On May 11, 1914, a boiler of the steamship "Jefferson" exploded, causing the loss of life of several persons. It was shown that this explosion had resulted from low water and consequent overheating of the boiler plates. This should have been indicated by the melting of the filling of the fusible plug in that region, but the plug was found to be unmelted and apparently sound. The plug was forwarded to the Bureau of Standards for determination of the cause of failure. A thorough investigation showed that the filling contained only traces of the original tin, embedded in a matrix of tin oxide, which upon test showed a melting point of 1,600° C. This oxide was distributed in such a form and quantity that it held the full steam pressure and would not have melted before the bronze of the plug casing or even the steel of the boiler plates. Actually such a plug constituted a serious hazard instead of a safeguard.

As a result of this investigation a thorough study was undertaken to determine the causes of the formation of this tin oxide. It was found that as little as 0.3 per cent of zinc or lead in the tin caused a dangerous deterioration, which was eliminated by insisting upon the use of a tin of high purity, containing not more than 0.3 per cent total impurities. Since this first work was undertaken 15 years ago the bureau has tested boiler plugs regularly for the Steamboat Inspection Service, and more recently another type of deterioration has been noted; that is, the formation during service of a hard refractory substance replacing the tin filling in the fire end of the plug.

Special apparatus was devised in which it was possible to test plugs under simulated service conditions of steam pressure and temperature. Through the cooperation of the Steamboat Inspection Service 184 plugs were returned in the condition as removed from boilers of various types, including low and high pressure boilers, both coal and oil fired. It was found that about 10 per cent of all plugs would not function when subjected to steam of a temperature slightly above the melting point of tin. The failure of the plugs to function was due in every case to the presence of a refractory material in the fire end consisting principally of oxides of copper and tin and in some instances of CaO and MgO. It was shown that the formation of tin and copper oxides was the result of a partial melting of the tin filling and subsequent oxidation. The calcium and magnesium oxides were shown to have come from the boiler water through a leak in the plug because of incomplete bonding of the filling to the casing. As a result of the investigation changes in the existing specifications for fusible plugs were recommended to the Steamboat Inspection Service which it is believed will prevent the crust formation and thus further insure the proper functioning of this valuable safety device.

SECOND PROGRESS REPORT ON SOIL-CORROSION STUDIES

The bureau's Technologic Paper No. 368 set forth the general plan of the soil-corrosion tests on pipe materials which were begun in 1922, and gave the results of observations on specimens taken up for examination in 1924 and 1926. A second progress report, including results of examination of the 1928 specimens, has now been published as Research Paper No. 95 in the August number of the Bureau of Standards Journal of Research. This paper will soon be obtainable separately by pur-

chase from the Superintendent of Documents, Government Printing Office.

The specimens treated in this paper include only ferrous pipe materials and cable sheaths. Soil characteristics, rather than differences in the composition of the ferrous pipe materials, appear to determine the type and extent of the corrosion observed. Tables in the paper show the relative corrosiveness of soils as indicated by rate of loss of weight and rate of increase in depth of pits. Although it happened that the same soil was worst from both of these points of view, the soil that ranked next to the worst from the standpoint of pitting ranked 28 as to loss of weight. As the specimens in the ground grew older the corrosion became more general, and in most soils there was a decrease in the rate of penetration. Field examination of cast-iron gas mains in several cities yielded data of a similar nature.

Considerable work has been done recently on methods of predetermining the corrosiveness of soils. The problem has not been solved.

Preliminary studies indicated that, in addition to the localized galvanic action caused by mill scale, differences in oxygen concentration, and other conditions, there are on pipe lines galvanic currents that result from the passing of the line through different soils. There appeared to be a relation between the discharge of these galvanic currents and the corrosion observed on the pipe line.

Additional specimens of pipe materials and coatings will probably be removed in 1930. In the meantime the bureau is compelled to reiterate its former conclusion that no valid comparisons of the length of service of various materials can yet be made on the basis of the data obtained in this investigation.

RESISTANCE OF METALS SUITABLE FOR DIES TO THE ABRASIVE ACTION OF PLASTIC CLAY

The abrasive action of plastic clay in flowing through dies wears the liners rapidly and makes necessary frequent renewals. Although it is well known that different metals show different resistances to the abrasion of plastic clay, no data appear to be available showing the relative "wear values" of different metals, such as those used for lining dies. Such an investigation has, therefore, been undertaken by the bureau.

The work includes tests on different kinds of cast iron, steel, and bronze. Up to the present time 10 tests have been made on cast iron and 44 on carbon-chrome steel.

During each test a definite volume of clay is extruded through the die specimen in a definite time, and the abrasive loss of the die is expressed in terms of volume. This is determined by dividing its loss in weight by the specific gravity of the metal.

A very small decrease in water content of the clay produces a marked increase in the pressure necessary to extrude the clay at a definite rate, and the abrasive loss of the die increases with the extrusion pressure. The data obtained from 54 tests indicate that the relation between extrusion pressure and abrasion loss of the metal is a "straight line" function according to the equation $\frac{P\,S}{W}=K$ in which P is the extrusion pressure, W the loss in weight of the metal, S the specific gravity of the metal, and K is a constant characteristic of the wearing quality of the metal.

Metals of highest resistance to abrasion will give the highest K values. The value of K for the cast-iron die as compared to that for the carbon-chrome steel die is as 1 to 10.116, which indicates that a clay column can be extruded from a carbon-chrome steel die ten times longer than that from the cast-iron die before the two dies show equal abrasive losses.

COMPRESSIVE STRENGTH OF CLAY BRICK WALLS

The October number of the Bureau of Standards Journal of Research will give a description of an investigation of the compressive strength of brick walls.

Results will be reported of compressive tests of 168 walls of common brick, each 6 feet long and about 9 feet high, and of 129 wallettes, about 18 inches long and 34 inches high. Four kinds of brick, 3 mortar mixtures, 2 grades of workmanship, different curing conditions, and 10 different types of masonry, 3 solid and 7 hollow, were the variables.

A very complete study was made of the strength properties of the brick. Compressive tests edgewise and flatwise, wet and dry; transverse tests edgewise and flatwise; tensile tests of whole brick, and absorption tests were made, each average being obtained from tests of 50 bricks of each kind. Shearing tests on a smaller number of samples were also made.

The results of these tests lead to the following conclusions:

1. The average strengths of solid walls built of end-cut Chicago brick (average compressive strength of half bricks flatwise, 3,280 lbs./in.^{2}) were as follows: Lime mortar walls, 287 lbs./in.^{2}; cement-lime mortar walls, 587 lbs./in.^{2}; cement mortar walls, 661 lbs./in.^{2} A contract

for building tests walls was let, on a lump-sum basis, to a brick mason who specialized in small contracts. The work was done without supervision and was characterized by absence of mortar in the longitudinal vertical joints and deep furrowing of the horizontal beds.

2. With carefully supervised workmanship, the average strengths of solid walls which were built by another mason hired by the day without regard to output and which had completely filled vertical joints and smooth spread horizontal mortar beds were as follows:

Chicago brick: Compressive strength of half brick flatwise, 3,280 lbs./in.^{2} Average compressive strength of solid walls—cement-lime mortar, not determined; cement mortar, 895 lbs./in.^{2}

Detroit brick: Compressive strength of half brick flatwise, 3,540 lbs./in.^{2} Average compressive strength of solid walls—cement-lime mortar, 945 lbs./in.^{2}; cement mortar, 1,145 lbs./in.^{2}

Mississippi brick: Compressive strength of half brick flatwise, 3,410 lbs./in.^{2} Average compressive strength of solid walls—cement-lime mortar, 1,300 lbs./in.^{2}; cement mortar, 1,550 lbs/in.^{2}

New England brick: Compressive strength of half brick flatwise, 8,600 lbs./in.^{2} Average compressive strength of solid walls—cement-lime mortar, 1,875 lbs./in.^{2}; cement mortar, 2,855 lbs./in.^{2}

3. The strengths of the solid walls were more closely related to the shearing strength of the bricks than to any other strength property measured. The compressive strength of the half bricks flatwise appeared to be the next best measure, and was better than the compressive strength on edge, the modulus of rupture, or the tensile strength of the bricks.

4. On the average the compressive strength of the wallettes was by far a more consistent measure of the strength of the walls than any of the brick strength values. In predicting wall strengths from brick strengths, effects of mortar and workmanship must be taken into account, while from wallette strengths, only a single value need be determined. These tests show that the average strength of the walls was from about 60 to 90 per cent of the average wallette strength.

5. The strength of the solid walls which were built by contract varied about as the cube root of the compressive strength of the mortar cylinders (2 inches in diameter and 4 inches long) which were made from the mortar of the walls and cured under the same conditions. For the solid walls built under careful supervision the increase in strength for cement mortar walls over those laid in cement-lime mortar was about 20 per cent for walls of Detroit and Mississippi brick and about 50 per cent for walls of New England brick, while the average ratio of the cube roots of the mortar cylinder strengths (cement and cement-lime mortars) was 1.38.

6. With brick, the cross sections of which closely approximated rectangles, the strengths of the hollow walls varied about as the net areas in compression. When the bricks were warped, the strength of the hollow walls was found to be less than that expected from the net area.

7. Construction data show that there is a saving in materials and in time for hollow walls of brick as compared with solid walls.

8. The condition of the horizontal mortar beds in the walls affected the wall strength. Walls in which the beds were smooth were stronger by from 24 to 109 per cent than walls in which the mortar beds were furrowed.

9. Walls laid in cement mortar and kept damp for seven days after construction were not stronger at the age of 60 days than similar walls cured in the laboratory under ordinary conditions.

10. The results of the wallette tests in which the same variables occurred as in the larger walls lead, in general, to the conclusions deduced from the wall tests.

CONSTRUCTION ACTIVITY DURING JULY, 1929

Construction contracts awarded in 37 Eastern States during July, 1929, as reported by the F. W. Dodge Corporation, were valued at $652,436,000, the highest total on record for the month of July and greater than in 1928 and 1927 by 12 and 22 per cent, respectively. The value of industrial building contracts was more than double that of July, 1928, and substantial increases were also made in public works and utilities, educational and public buildings, and hospitals and institutions, while residential, commercial, social, and religious building contracts were less in value than a year ago.

The cumulative value of awards during the first seven months of the year was $3,684,243,000, a decline of 9 per cent in comparison with $4,030,200,000 in 1928, but approximately the same as during the two preceding years. Last year's totals for the corresponding period were exceeded only in the Minneapolis and Southeastern districts. Of the principal classes of construction, industrial building contracts were greater in value than last year by 36 per cent, and both commercial building and public works and utilities by 3 per cent. Awards for public buildings, though not

one of the major classes of construction, were more than half as large again as a year ago.

SAN FRANCISCO BRANCH LABORATORY

About 10 years ago the bureau established at San Francisco a laboratory to take care of the inspection and testing of cement bought by the various Government departments on the Pacific coast. Previous to that time such services had been rendered by the Denver branch of the bureau, but the increased requests for such service led to the bureau's placing a laboratory in San Francisco.

The promptness with which the services could be rendered was very much appreciated by the various departments and gradually there grew up an insistent demand that the bureau extend its work to the testing of other commodities. This was acceded to and gradually the bureau extended its personnel and equipment to the extent that it was able to test, in addition to cement and concreting materials, steel and other metals, paints, oils, varnishes, and gasoline.

As a result of recent requests by the departments on the Pacific coast for extending the work, arrangements are being made for increasing the personnel and equipment so that the bureau will be able to make the usual physical and chemical tests of practically all varieties of materials purchased by the Government, excepting medicinal supplies and foods, at the San Francisco branch. At the present time the equipment is being purchased and the personnel being trained in the testing of the materials not previously taken care of, such as textiles, rope, rubber and rubber products, paper, etc. Because of the necessity of taking over some space now occupied by others, and the consequent rearrangement of the laboratory, the branch at San Francisco, in the Appraisers Building, will not be ready for such additional testing until about the first of December.

NEW AND REVISED PUBLICATIONS ISSUED DURING AUGUST, 1929

Journal of Research [1]

Bureau of Standards Journal of Research, Vol. 3, No. 2, August, 1929. (RP Nos. 91 to 98, inclusive.) Obtainable only by subscription. (See footnote.)

Commercial Standards Monthly [1]

CSM. Vol. 6, No. 2. Commercial Standards Monthly, August, 1929. Obtainable only by subscription. (See footnote.)

Simplified Practice Recommendations [1]

R28–29. Sheet steel. Price, 10 cents.
R98–29. Photographic paper. Price, 10 cents.

Commercial Standards [1]

CS10–29. Brass pipe nipples. Price, 5 cents.

Technical News Bulletin [1]

TNB149. Technical News Bulletin, September, 1929. Obtainable only by subscription. (See footnote.)

OUTSIDE PUBLICATIONS [2]

Experiments in Recording Radio Signal Intensity. L. W. Austin; Proceedings, Institute of Radio Engineers (New York, N. Y.), Vol. 17, No. 7, p. 1192; July, 1929.

Relation of Radio Propagation to Disturbances in Terrestrial Magnetism. I. J. Wymore; Proceedings, Institute of Radio Engineers (New York, N. Y.), Vol. 17, No. 7, p. 1206; July, 1929.

How to Determine Wire Sizes for Electromagnets. H. B. Brooks; Industrial Engineering (Chicago, Ill.), Vol. 87, p. 349; July, 1929.

Fire Resistance Tests of Building Materials and Constructions. S. H. Ingberg; Safety Engineering (New York, N. Y.), Vol. 53, No. 1, p. 13; July, 1929.

Automotive Headlight Requirements from the Driver's Point of View. H. C. Dickinson and H. H. Allen; Transactions, Illuminating Engineering Society (New York, N. Y.), Vol. XXIV, No. 1, p. 15; January, 1929.

Type Testing of Commercial Airplane Engines of Medium Power. H. K. Cummings; Transactions, American Society of Mechanical Engineers (New York, N. Y.), Aeronautical Engineering, Vol. 1, No. 2, p. 45; April–June, 1929.

Operating Factors and Engine Acceleration. D. B. Brooks; Society of Automotive Engineers Journal (New York, N. Y.), Vol. XXV, No. 2, p. 130; August, 1929.

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[1] Send orders for publications under this heading with remittance only to the Superintendent of Documents, Government Printing Office, Washington, D. C. Subscription to Technical News Bulletin, 25 cents per year (United States, Canada, Cuba, Mexico, Newfoundland, and Republic of Panama); other countries, 40 cents. Subscription to Bureau of Standards Journal of Research, $2.75; other countries, $3.50. Subscription to Commercial Standards Monthly, $1; other countries, $1.25.

[2] "Outside publications" are not for distribution or sale by the Government. Requests should be sent direct to publishers.

Program for Determination of Effect of Engine Design on Acceleration. D. B. Brooks; Society of Automotive Engineers Journal (New York, N. Y.), Vol. XXV, No. 2, p. 174; August, 1929.

Volatility Data on Natural Gasoline and Blended Fuels. O. C. Bridgeman; Society of Automotive Engineers Journal (New York, N. Y.), Vol. XXV, No. 2, p. 137; August, 1929.

The cooperative fuel research and its results. H. C. Dickinson; Society of Automotive Engineers Journal (New York, N. Y.), Vol. XXV, No. 2, p. 171; August, 1929.

Results from cooperative research. H. C. Dickinson; Oil and Gas Journal (Tulsa, Okla.), vol. 28, No. 11, p. 46; August 1, 1929.

The structure of alpha methylxyloside. F. B. Phelps and C. B. Purves; Journal, American Chemical Society (Washington, D. C., vol. 51, p. 2443; August, 1929.

Röntgen-ray protection. L. S. Taylor; The American Journal of Röntgenology and Radium Therapy (New York, N. Y.), Vol. XXII, No. 1, p. 45; July, 1929.

Progress report on investigation of sagger clays, V. R. A. Heindl and L. E. Mong; Journal, American Ceramic Society (Columbus, Ohio), vol. 12, No. 7, p. 457; July, 1929.

Measurement in Government service. H. D. Hubbard; The Valve World (Crane Co., Chicago, Ill.), Vol. XXVI, No. 8, p. 267; August, 1929.

The following articles were published in the series on "Industrial Research" in the United States Daily (Washington, D. C.):

Hugh G. Boutell:

How the Bureau of Standards Tells its Story; August 19, 1929.

Publications of the Bureau of Standards; August 20, 1929.

Henry D. Hubbard:

A Journal of Research; August 17, 1929.

Research Regarding Rubber; August 21, 1929.

Examples of Rubber Research; August 22, 1929.

Sugar; August 23, 1929.

Paper; August 31, 1929.

Aircraft Materials; September 3, 1929.

Aeronautical Instruments; September 4, 1929.

Leather; September 5, 1929.

Manufacture of Leather; September 6, 1929.

H. S. Rawdon:

Studies of Metals; August 24, 1929.

C. E. Waters:

Chemical Studies; August 26, 1929.

The Metallurgy of Gases; August 27, 1929.

Oil and Rubber; August 28, 1929.

Leather and Textiles; August 29, 1929.

Pottery and Glass; August 30, 1929.

U. S. GOVERNMENT PRINTING OFFICE: 1929